

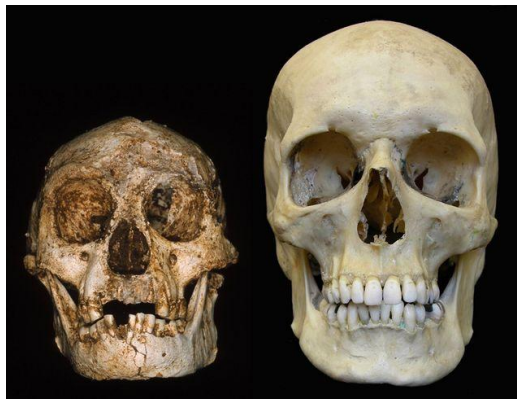
Unit 1: Evolution

AP Biology

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What is Evolution?

- A change in the genetic makeup of a **population** over time is evolution.



What Leads to Evolution?

- Individuals vary genetically & DNA can mutate
- Results in varied phenotypes



What Leads to Evolution?

- Environments change constantly
 - How?
- Results in some individuals having **adaptations** that allow them to survive and reproduce more frequently than others
- **Evolutionary Fitness depends on the particular environment!**

Bighorn Sheep



Plant Trichomes



- Why is **variation** important to the survival of a species?

What Leads to Evolution?

- **Artificial Selection:** Humans artificially select for desired traits
 - Examples?
- **Natural Selection:** Nature “selects” individuals best suited to their environment to survive and pass on their genes. This leads to a change in the gene pool over time.

What Leads to Evolution?

- **Natural Selection** is the major mechanism of evolution.
- Other mechanisms? Of Course!
 - Genetic Drift
 - Random chance that some more successful
 - Non-Random Mating: mate preferences
 - Migrations: movement in and out of population
 - Mutations: change genetics (DNA) randomly

Modeling Evolution

- The Hardy-Weinberg Model
 - This is a NULL model: if assumptions are met, it models that NO evolution is occurring.
 - If a change from 1 generation to the next IS observed, this demonstrates that evolution IS occurring.

H-W Assumptions

- No Natural Selection (not likely)
- No mutations (not likely)
- No migration (maybe)
- Random mating (not likely)
- Large population size (maybe)

All conditions seldom met!

H-W Model

$$p^2 + 2pq + q^2 = 1$$

$$p + q = 1$$

p^2 = decimal of **homozygous dominant** individuals

$2pq$ = decimal of **heterozygous** individuals

q^2 = decimal of **homozygous recessive** individuals

p = decimal of **dominant alleles**

q = decimal of **recessive alleles**

Practice Problem

- In a population of 100 trees, 30 individuals are homozygous recessive for small trichomes.
- If the population is in HW equilibrium (no evolution occurring), how many dominant alleles should be in the population next generation?
- How many heterozygous individuals should there be?

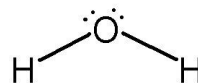
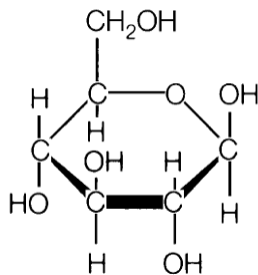
Evidence for Evolution

- Genetic data
 - DNA and Protein sequence similarities



Evidence for Evolution

- Bimolecular data
 - Similar compounds conserved
 - Glucose: Energy source of life
 - Water: Solvent of life



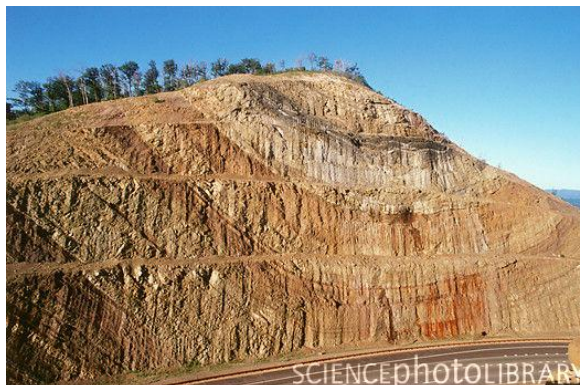
Evidence for Evolution

- Morphological data
 - Homologous structures
 - Embryo similarities



Evidence for Evolution

- Fossil dating
 - Age of rock
 - Isotope decay (Carbon-14)



Evidence for Evolution

- Disciplines other than biology provide evidence
 - Geography
 - Geology
 - Chemistry
- Mathematical models assist also
 - HW model
 - Molecular sequence databases
 - Phylogenetic analysis

- A Tyrannosaurus Rex femur was found in southern Africa within a rock formation and a second unidentified dinosaur bone was found in the same rock formation, about 4 meters away. Describe how you could figure out if the 2 bones were from the T-Rex or if the second bone was completely different. Justify your answer!

- The Genetic Code

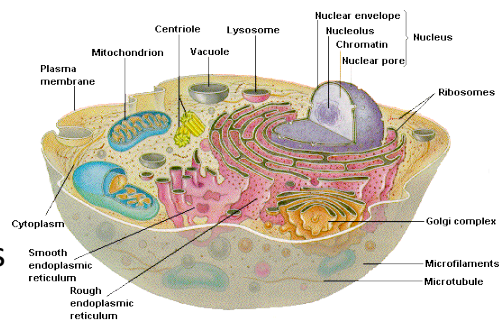


Conserved Features

- Metabolic Processes
 - Glycolysis in ALL organisms
 - Metabolize glucose for energy
 - Photosynthesis (Plants, algae, cyanobacteria)
 - Create carbon compounds from CO_2 & Water

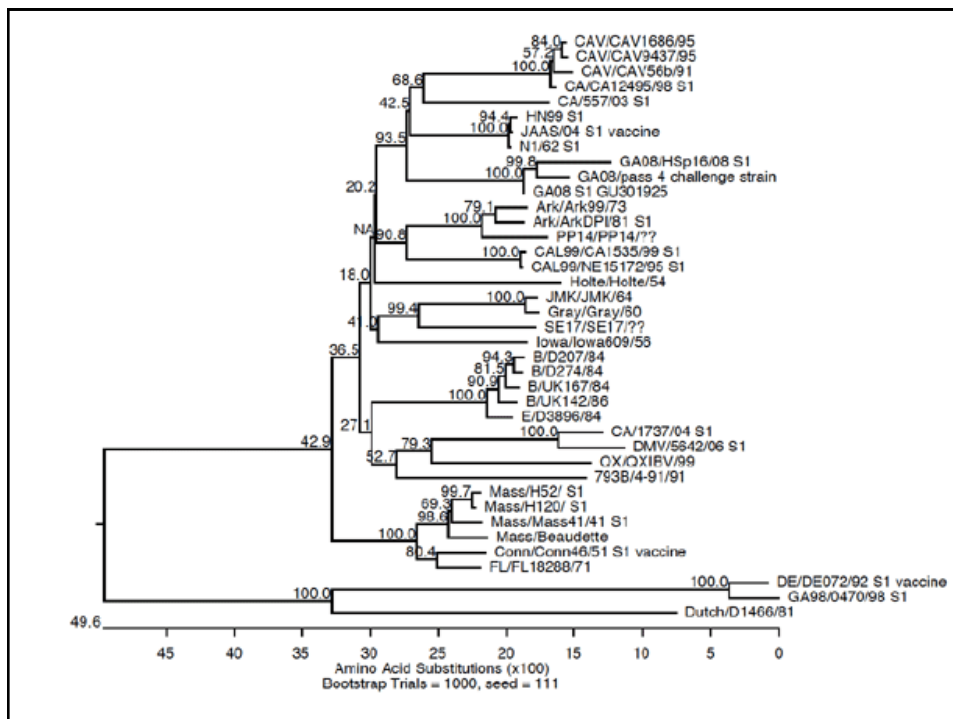
Conserved Features

- Eukaryotes
 - Cytoskeleton (structural proteins)
 - Membrane-Bound Organelles
 - Linear Chromosomes
 - Endomembrane transit systems



Modeling Ancestry: Phylogenies

- Phylogeny: An organism's evolutionary history
- Illustrate
 - relatedness to others
 - Speciation timing
- Data from
 - Morphology
 - Genetic data
- Computers for complex modeling
- Constantly being revised based on new data!

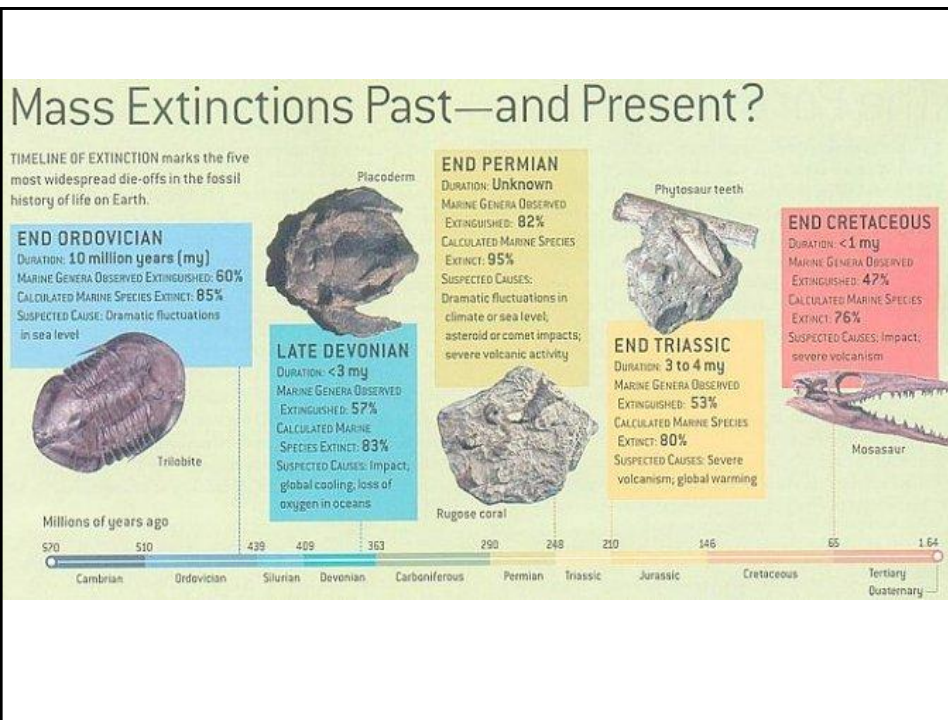


Speciation

- Result of reproductive isolation from
 - Geologic events: Floods, volcanic eruptions
 - Reproductive barriers
 - Pre-zygotic: reproductive structure incompatibility
 - Post-zygotic: Hybrid sterility/mortality
 - Mutations: Polyploidy in plants
- Leads to a diversity of life forms

Speciation

- Rates of speciation vary widely
 - Habitat availability, competition, geologic events
- Extinction can be rapid if ecosystem is stressed
 - Dinosaurs
 - Human impacts on Tropical Rainforests



Origin of Life on Earth?

- **Biological Theory**
 - Earth had many inorganic molecules that slowly changed to organic forms due to available energy and low oxygen (oxygen was TOXIC then!)
 - Became building blocks for complex molecules (amino acids, nucleotides, fats, sugars)
 - Led to forming polymers with the ability to replicate, store and transmit information (RNA first?)
 - Able to occur in solution or solid reactive surfaces

Origin of Life on Earth?

- Exact date of life's first appearance unknown
- Earth formed about 4.6 bya (billion years ago)
- Too hostile for life until 3.9 bya
- Earliest fossils 3.5 bya
- Likely between that window of time

Evidence of Common Ancestral Origin on Earth

- Common building blocks of life
Such as?
- Universal genetic code